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BOTANY.[1]

THE GROWTH OF PLANTS WATERED WITH ACID SOLUTIONS.—In the September and October numbers of the AMERICAN NATURALIST for 1883, the writer published the results of an examination of the effects of watering, with acid solutions, growing plants of the silver-leaf geranium, and he there stated his intention of continuing his experiments in this direction by growing the same plant under similar or identical conditions upon siliceous, feldspathic and calcareous soils. These experiments were made in the summer of 1884, and the results obtained form the substance of this paper.

The conclusion seemed warranted by my previous experiments that the acids had a tendency to increase the ash or mineral ingredients of the plant, and this inference led me to suppose that if the soils used were highly mineralized the deleterious action of the acids upon the plant tissue would be diminished and at the same time the introduction into the plant of mineral substances increased. The soils were prepared and the plants potted about July 1st, the proportion of pulverized mineral in all cases being from twenty-five to thirty per cent of the whole, for the silica common cement sand was used, and the earth was taken from garden mold. The strengths of the acid solutions used were as follows: Of hydrochloric, nitric, sulphuric and carbolic 10^{cc} of the concentrated acid to one liter of water; of oxalic, tartaric, tannic, citric and formic 20^{cc} of the saturated solutions to one liter of water. Ordinary flesh-colored feldspar from granite veins in the gneiss rock of Manhattan island was powdered and used for the feldspathic tests, and dolomitic marble from Westchester county similarly treated and mixed in thoroughly with the mold to make a calcareous soil.

The tables following show the results obtained in all my experiments, including those of 1882. The first set of tables shows the state of leafiness of the plants at different times, and the second the percentage of ash with the weight of the dried plant at the end of the experiment.

Experiment of 1882 with garden mold for soil:

	June 25.	*July 13.*	*Aug. 24.*
Hydrochloric	6 full leaves	6 full leaves	5 full leaves
Nitric	5 "	4 "	2 "
Carbolic	4 "	2 "	none
Formic	4 "	6 "	5 full leaves
Salicylic	6 "	7 "	4 "
Sulphuric	7 "	5 "	2 "
Tartaric	7 "	9 "	9 "
Tannic	6 "	9 "	9 "
Citric	5 "	7 "	7 "
Water	11 "	13 "	17 "

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[1] Edited by PROFESSOR CHARLES E. BESSEY, Lincoln, Nebraska.

Experiments of 1883 with siliceous, feldspathic and calcareous soils:

SILICEOUS.

	July 5.	*July 22.*	*Aug. 16.*	*Sep. 1.*
Hydrochloric	5 leaves	5 leaves	5 leaves	4 leaves
Nitric	6 “	7 “	3 “	4 “
Carbolic	4 “	3 “	0 “	0 “
Sulphuric	4 “	4 “	0 “	0 “
Formic	5 “	6 “	5 “	4 “
Oxalic	5 “	7 “	7 “	6 “
Citric	4 “	6 “	6 “	4 “
Tannic	5 “	6 “	7 “	5 “
Tartaric	5 “	7 “	7 “	5 “
Water	4 “	7 “	6 “ + fl.	5 “

FELDSPATHIC.

	July 5.	*July 22.*	*Aug. 16.*	*Sep. 1.*
Hydrochloric	5 leaves	6 leaves	5 leaves	3 leaves
Nitric	3 “	2 “	2 “	2 “
Carbolic	5 “	4 “	3 “	1 “
Sulphuric	4 “	4 “	0 “	0 “
Formic	5 “	5 “	4 “	5 “
Oxalic	3 “	5 “	6 “	6 “
Citric	5 “	7 “	8 “	6 “
Tannic	5 “	7 “	5 “	5 “
Tartaric	4 “	7 “	9 “	6 “
Water	4 “	5 “	6 “	5 “

CALCAREOUS.

	July 5.	*July 22.*	*Aug. 16*	*Aug. 22.*
Hydrochloric	4 leaves	5 leaves	3 leaves	2 leaves
Nitric	4 “	2 “	1 “	0 “
Carbolic	5 “	3 “	2 “	2 “
Sulphuric	4 “	2 “	1 “	0 “
Formic	3 “	4 “	5 “	5 “
Oxalic	5 “	7 “	5 “	6 “
Citric	4 “	5 “	7 “	7 “
Tannic	3 “	5 “	5 “	5 “
Tartaric	5 “	5 “	7 “	5 “
Water	5 “	7 “	7 “	7 “

The condition of the plants in these prepared soils varied materially from that of those grown in 1882 in garden mold. They were much more stunted and did not in the most favorable cases put out as many leaves as those of 1882.

The contrast, however, in leafiness between the plants watered with acids and those treated with water alone is far less marked in the artificial soils than in the case of the same tests in ordinary mold. The tables show this. In both experiments the inorganic acids and carbolic acid acted most deleteriously upon the plants, while under the application of the dilute organic acids the plants maintained a comparatively vigorous growth.

The relative condition of the plants at the end of the experiment as compared with that at the beginning was nearly the same in both sets of experiments, viz., with the inorganic and carbolic acids they underwent a slow devitalization culminating in the death of the plant, or a very reduced state of health, while with the other acids they apparently resisted their weakening influence more successfully, and while not assisted were but slightly injured by their presence in the soil. The mineralized soils proved uncongenial for the plant, but in this case the plants watered with organic acids and those treated with water showed a very similar if not identical state of health.

However, the conjecture that in the mineralized soils the acid-watered plants would show an increase in ash over the water-plant seems confirmed by the following tables of the results obtained.

Experiment of 1882 with garden mold for soil:

	Wt. dried plant.	*Percentage ash.*
Nitric	0.536 grammes	16.79
Carbolic	0.5135 "	16.60
Formic	0.5535 "	18.15
Salicylic	0.5885 "	17.00
Tannic	0.6975 "	19.80
Tartaric	0.9325 "	14.74
Water	1.1615 "	19.11

Experiments of 1883 with siliceous, feldspathic and calcareous soils:

SILICEOUS.

	Wt. dried plant.	*Percentage ash.*
Hydrochloric	.904 ? grammes	19.46
Nitric	.932 ? "	17.36
Carbolic	.532 "	17.48
Sulphuric	.357 "	19.60
Formic	.683 "	20.05
Oxalic	.597 "	21.77
Citric	.521 "	20.92
Tannic	.729 "	19.82
Tartaric	.779 "	19.77
Water	.951 "	20.51

FELDSPATHIC.

	Wt. dried plant.	*Percentage ash.*
Hydrochloric	.6395 grammes	21.50
Nitric	.510 "	22.15
Carbolic	.904 "	14.93
Sulphuric	.400 "	22.00
Formic	.757 "	20.67

FELDSPATHIC.

	Wt. dried plant.	*Percentage ash.*
Oxalic	.7575 grammes.	19.09
Citric	.895 "	19.87
Tannic	1.233 "	16.22
Tartaric	.7875 "	18.92
Water	1.2115 "	16.01

CALCAREOUS.

	Wt. dried plant.	*Percentage ash.*
Hydrochloric	.677 grammes	19.35
Nitric	.543 "	22.30
Carbolic	.692 "	16.18
Sulphuric	.502 "	20.10
Formic	.512 "	22.85
Oxalic	.521 "	23.41
Citric	.783 "	20.24
Tannic	.5985 "	18.13
Tartaric	.732 "	19.26
Water	1.33 "	16.39

With the exception of the plants growing in the siliceous soil the other plants, putting aside the carbolic acid plants whose enfeebled condition barely permitted them to retain their vitality, show a markedly higher percentage of ash over that found in the water plants. It would seem as if the acids had dissolved to some extent the feldspar and dolomite, and permitted the plants to assimilate more of the mineral substances of the soils, but that this action in the siliceous soil had been prevented or retarded by the more insoluble character of its ingredients. Even in the latter instance they approach in their percentage of ash more closely to the water plant than in the experiment made with the unmineralized soil. The varying *special* details of the experiments should not in this connection be made the basis of any general conclusion, as unequal exposure to the flame in reducing the plant to ash gives rise to important differences in the weights of the residual salts. But it is apparently justifiable to conclude that the action of acid upon soil containing growing plants is to increase the mineral constituents of the latter, and that slightly acid waters percolating through a pulverulent soil richly provided with comminuted and impalpable matter would assist its introduction into plants needing these elements.

Professor Stockbridge, in a report to the Board of Agriculture of Connecticut in 1876, says that, "Every plant contains silica, potash, soda, lime, magnesia, phosphoric and sulphuric acids, chlorine and iron, and in order to have soils feed plants the material must be brought into such condition that the vital force can use it." This is of course obvious, and the slow corrosive action of terrestrial waters and falling rains in decomposing the mineral components of soils is doing that very thing. The experiments described and their results are a very exaggerated form of the natural processes prevalent about us. The plants, though injured in their growth and their consequent powers of absorption, by the quite acid solutions used, showed as high and *higher* percentages of mineral matter in the ash as did the water-fed plants which were unimpeded in their nutritive processes by an injurious treatment. Experiments may now be undertaken upon phosphatic (insoluble phosphate) soils with the same means.—*L. P. Gratacap, New York City.*

Botanical News.—Papers on the following subjects occur in the later numbers of *Annales des Sciences Naturelles*, viz., Characters of the principal families of Gamopetalæ drawn from the anatomy of the leaves, by Julien Vesque; The dissemination of the spores of vascular Cryptogams, by Leclerc du Sablon; Notes on some new or little-known parasitic Fungi, by V. Fayod. In the latter are noticed *Endomyces parasiticus* Fayod, a new species parasitic on the gills of *Agaricus rutilans; Peziza mycetophila* Fayod, another new species parasitic on *Agaricus vellereus;* and *Hypomyces leotiarum* Fayod, parasitic on *Leotia lubrica.*——Late numbers of *Flora* contain the following articles, viz.: New Lichens of Bering's straits, by W. Nylander; New North American species of Arthronia, by W. Nylander; The opening and unrolling of fern sporangia and anthers, by J. Schrodt.——In the last *Hedwigia* Professor Oudemans describes a new species of rust, *Puccinia veronicæ-anagallidis.*——The September *Journal of Mycology* is devoted wholly to a description of the North American species of Glœosporium, forty-seven in all.——In *Grevillia*, M. C. Cooke describes a large number of new British Fungi; and Cooke and Plowright describe twenty California Fungi, including one interesting rust, *Uromyces puncto-striatum*, on twigs of Rhus.——The *Journal of Botany* for September contains a valuable paper on the caulotaxis of British Fumariaceæ, by Thomas Hick; A list of European Carices (151 species), by Dr. H. Christ; and a Classification of garden roses, by J. G. Baker, in which sixty-two species are recognized.——Late numbers of the *Botanische Zeitung* contain papers by Arthur Meyer on the Assimilation-product of the leaves of angiospermous plants, and by Solms-Laubach on the Sexual differences of fig trees.——The most important botanical articles in the September *Gardeners' Monthly* are, The destruction of trees by coal gas, by H. F. Hillenmeyer; The curl in the peach, and The age of yew trees.——Late numbers of the *Gardeners' Chronicle* contain a review of the genus Odontoglossum, by James O'Brien (accompanied with many wood-cuts); a notice of the Chelsea Botanic Garden; The cross-breeding of cereals; Disease and decay in fruit, by W. G. Smith; a notice of the life of Dr. Regel, the venerable director of the Imperial Botanic Garden of St. Petersburg; a description of a new Brazilian species of Aristolochia (*A. elegans*); figures and descriptions of *Peronospora pygmæa* and its resting spores.